

The logo for AKNIA, with 'AKNIA' in a large, white, sans-serif font. The letters 'N' and 'I' are partially obscured by a vertical line that separates the dark bokeh background on the left from the portrait of a man on the right.

AKNIA

PASSION FOR
TECHNOLOGIES

TEST AUTOMATION FOR FUNCTIONAL VALIDATION IN AD APPLICATIONS

From virtual world to real world vehicle testing

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IPG Apply & Innovate



TEST AUTOMATION FOR FUNCTIONAL VALIDATION IN AD APPLICATIONS

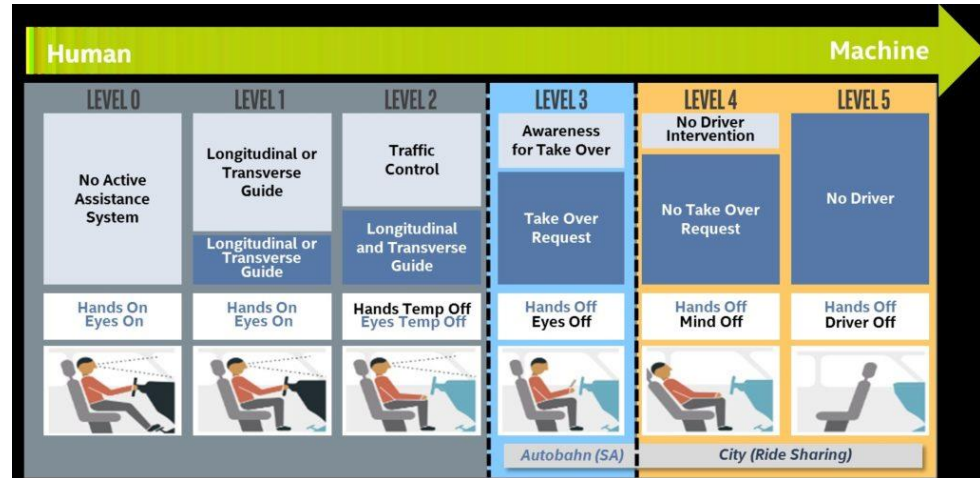
- 1 | Test & Validation of Autonomous Driving – A Motivation
- 2 | Seamless Testing for Validation of Autonomous Driving Functions
- 3 | “Realtime” Test Manager Board
- 4 | Summary

AUTONOMOUS DRIVING

- “Almost all OEMs offer mass-produced vehicles with automated driving functions”¹
- “**Testing** remains a focal area for research; **test facilities** being built up worldwide”¹
- **Testing** in real conditions on **public highway**¹
 - different countries, different laws, different approval procedures



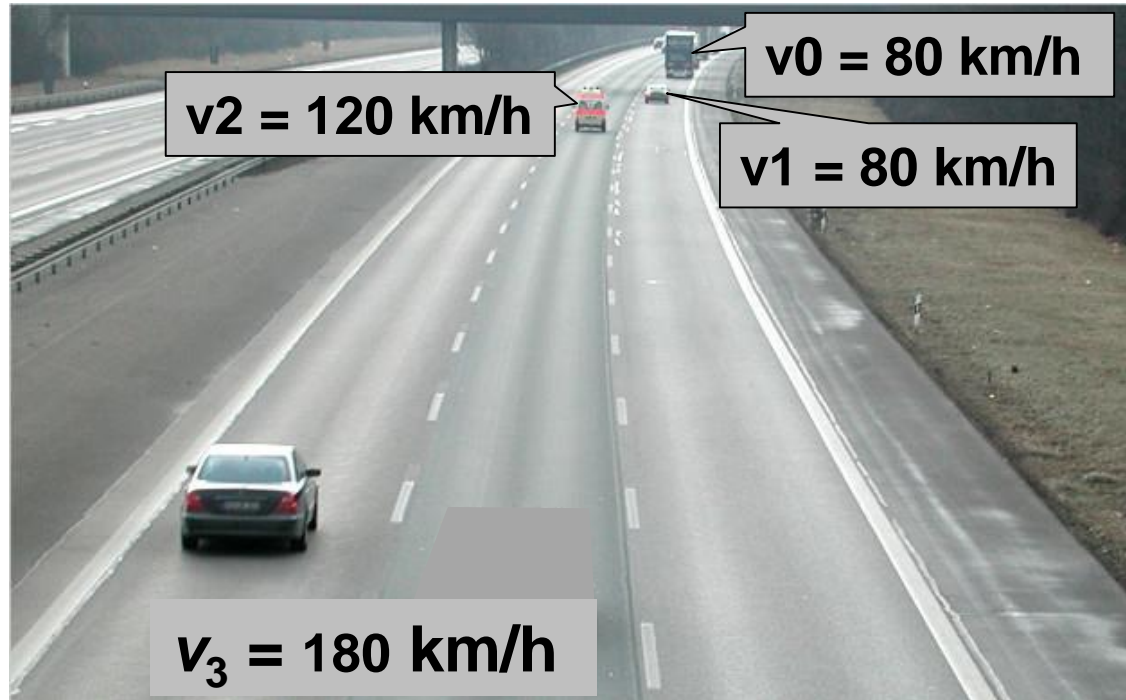
- **Simulation** as method **to test automated vehicles**
 - 2016: > **3.5 billion virtual km** ⇔ 5 million "real" km physical test cars over the past eight years.¹



Five stages of autonomy. (Reference: [IQ Intel](https://iq.intel.com/autonomous-cars-road-ahead/) <https://iq.intel.com/autonomous-cars-road-ahead/>)

¹ Reference: STUDY - Automated Vehicles Index - Q4 2017 - Roland Berger GmbH – Automotive Competence Center & fka Forschungsgesellschaft Kraftfahrwesen mbH, Aachen January 2018

COMPLEXITY OF DRIVING SITUATION – OVERTAKING (1)



Reference: Prof. Dr. Eric Sax (FZI am KIT) – Testen - Vom Labor auf die Straße und zurück (VDI-Vortrag, Böblingen, Januar 2018)

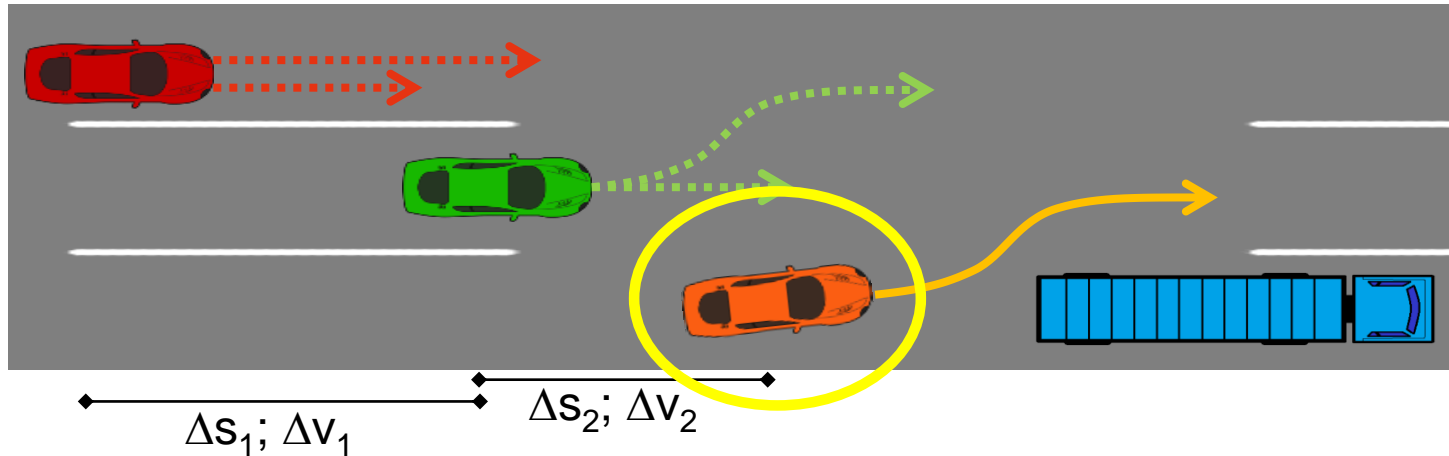
COMPLEXITY OF DRIVING SITUATIONS – OVERTAKING (2)



Reference: Prof. Dr. Eric Sax (FZI am KIT) – Testen - Vom Labor auf die Straße und zurück (VDI-Vortrag, Böblingen, Januar 2018)

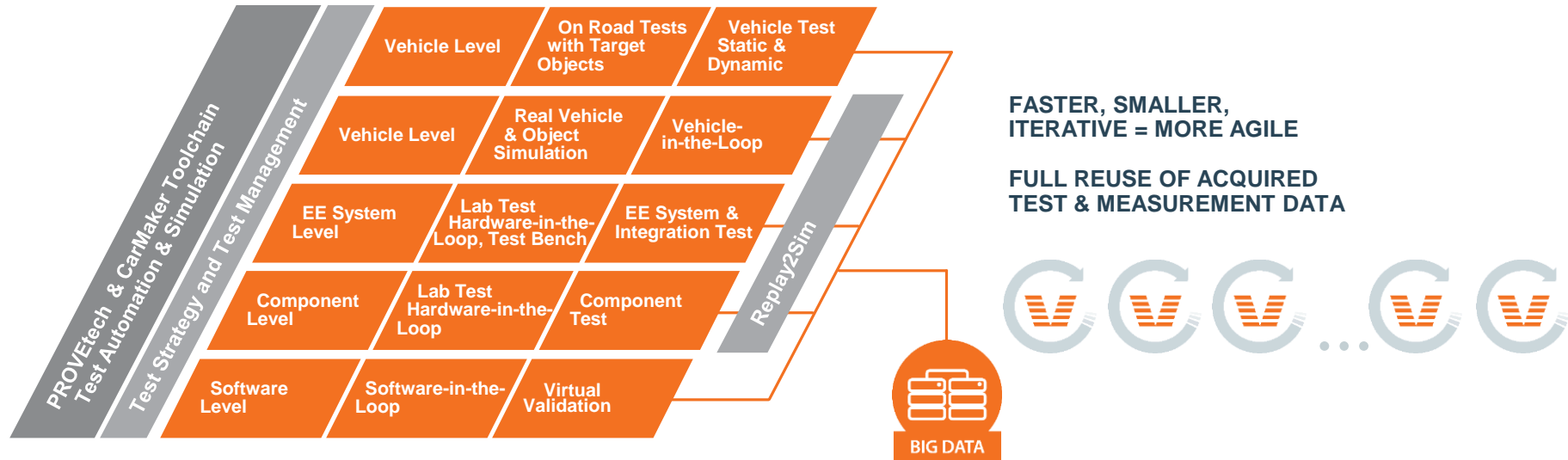
COMPLEXITY OF DRIVING SITUATION – OVERTAKING (3)

Initial Situation: speed of blue truck and orange car is 80 km/h → orange car initiates overtaking maneuver



- Δv from 0 km/h to 120 km/h in 10 km/h steps → 12 variants
- Δs from 0 m to 100 m in 10 m steps → 10 variants
- Two pairs → $12 \cdot 12 \cdot 10 \cdot 10 = \mathbf{14,400}$ variants for initial situation

ONE TEST STRATEGY & TEST PLAN TO PERFORM INFINITE HOURS OF DRIVING ACROSS ALL TEST LEVELS

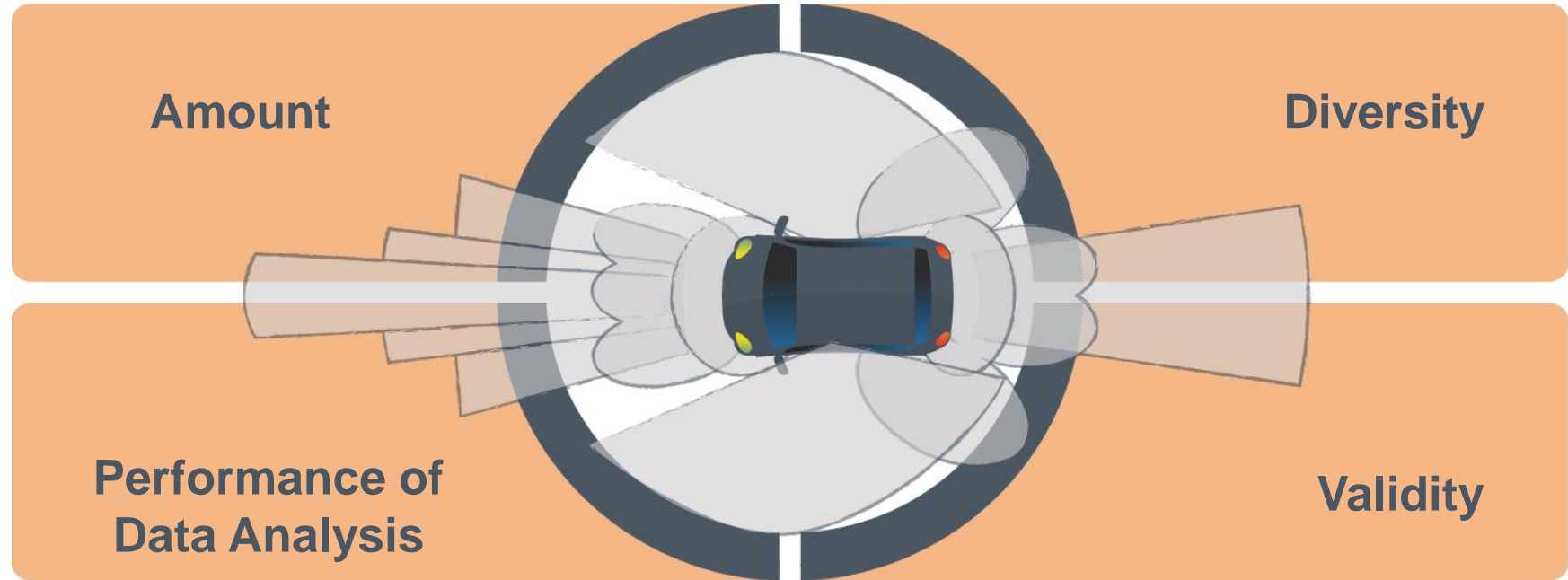


TEST AUTOMATION WITH PROVEtech:TA & SIMULATION WITH IPG CarMaker

The image is a composite of three parts:

- Instrument Cluster (Left):** A close-up of a car's dashboard featuring a central speedometer with a needle pointing to 100 km/h, a tachometer on the left, and a fuel gauge on the right.
- Simulation Interface (Right):** A screenshot of the IPG CarMaker simulation software. It shows a white car driving on a road. A red sensor cone is visible in front of the car. The interface includes a steering wheel icon in the top right and various data panels at the bottom.
- Data Panels (Bottom):**
 - ECU PowerSupply:** A list of ECU components with status indicators (red squares).
 - ACC Icon:** A graphic of the Adaptive Cruise Control (ACC) icon, showing a car on a road with a blue arrow pointing to the right.
 - Information panel:**
 - Ego vehicle desired speed (km/h): 136.20
 - Ego vehicle actual speed (km/h): 99.90
 - Front vehicle actual speed (km/h): 100.00
 - Desired distance to front vehicle (m): 41.63
 - Actual distance to front vehicle (m): 42.91
 - ACC buttons:** A set of virtual buttons for controlling ACC, including 'Resume', 'Spd+10km/h', 'DistUp(+)', 'ACC_ON', 'Spd-1km/h', 'DistDn(-)', and 'Spd-10km/h'.
 - Manipulation:** Controls for the 'Ego Vehicle' (Brake, Overtake) and 'Front Vehicle' (Manipulate Speed, Set).

BIG DATA: NOT ONLY THE AMOUNT OF DATA

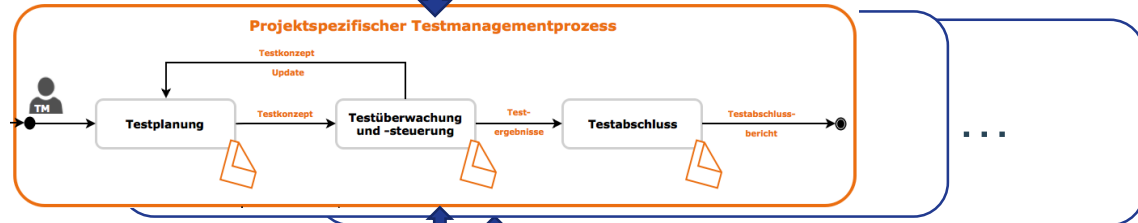


TEST MANAGER BOARD

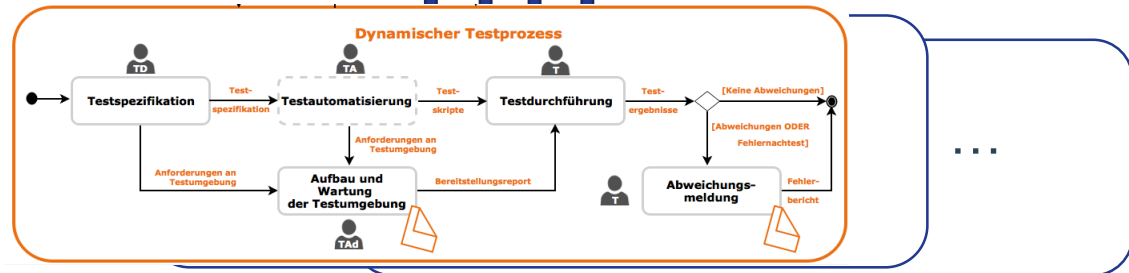
Test Management Process



Test Level Management Process



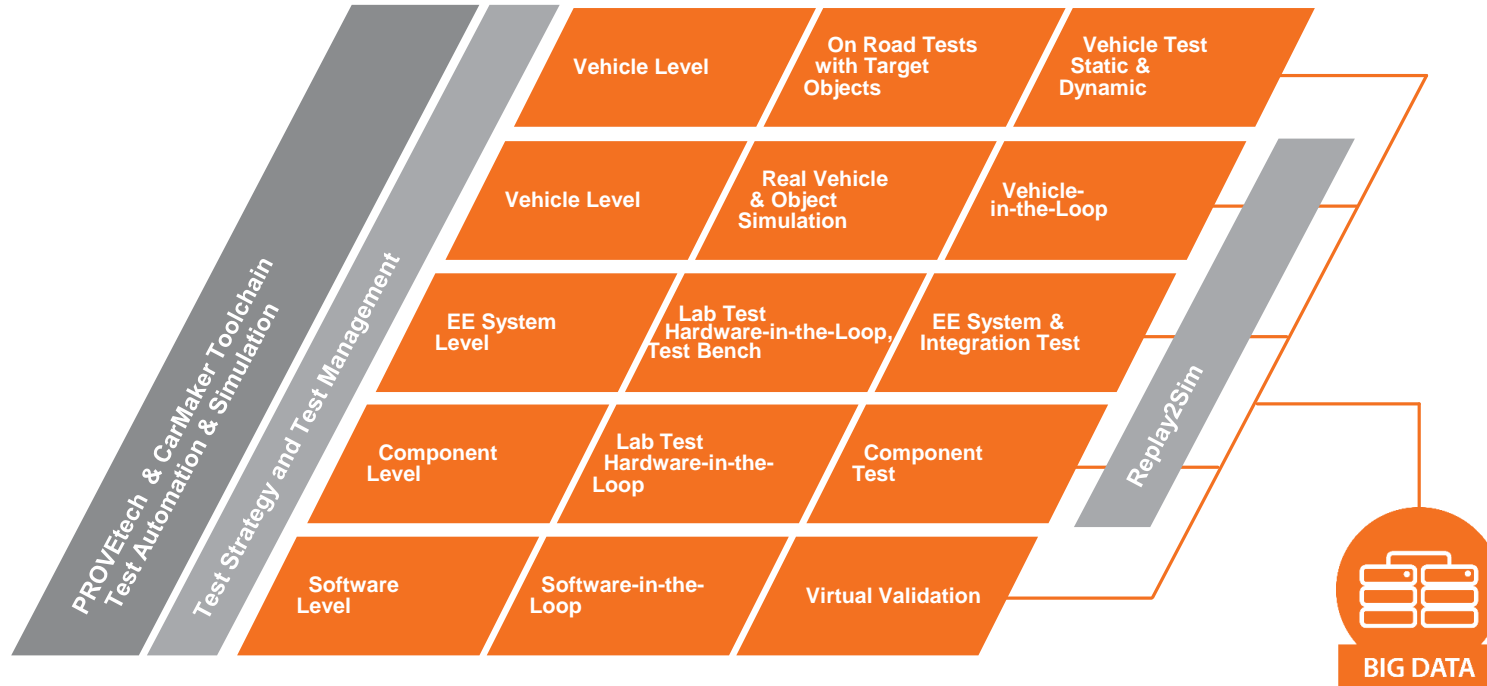
Dynamic Test Process



Reference: ISO 29119 + AKKA Digital

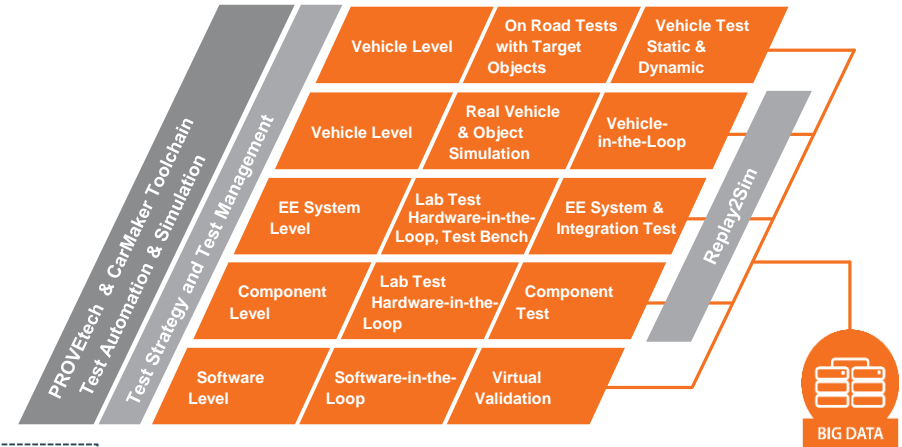
Ticket System for Issue Tracking

TRACK DOWN THE BUG



SEAMLESS TESTING & “REALTIME” TEST MANAGER BOARD

- One test strategy & test plan to perform infinite hours of driving across all test levels
- “Realtime” Test Manager Board



Classic derivation:
Test spec. on base of
AD¹ fct. spec.

- Isolated on each test level
- Counting test cases
- Deterministic testing

Paradigm Shift

Test driving scenes from
manoeuvre catalogues

- Seamless over all test levels
- Counting thousands of hours or millions of kms
- “Statistic” validation

**FASTER, SMALLER,
ITERATIVE = MORE AGILE**

**FULL REUSE OF ACQUIRED
TEST & MEASUREMENT DATA**



¹ AD = Autonomous Driving

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THANK YOU.
QUESTIONS?

